CLAIMS

What is claimed is:

1. A magnetoresistive random access memory (MRAM) unit comprising:

a substrate;

a plurality of memory cells formed on said substrate; and

a plurality of electrical wires electrically coupled to said plurality of memory cells;

wherein each of said plurality of memory cells comprises a synthetic antiferromagnetic pinned (SAFP) recording layer, wherein said SAFP recording layer comprises two or more antiferromagnetically coupled ferromagnetic layers pinned by at least one antiferromagnetic layer, and

wherein said plurality of memory cells together with said plurality of electrical wires are adapted for a heating current flowing therethrough to heat a respective one of said plurality of memory cells and wherein said plurality of electrical wires is adapted for writing currents flowing therethrough to change a magnetization of said SAFP recording layer of said heated respective one of said plurality of memory cells.

2. The MRAM unit according to claim 1, wherein between each two neighboring ferromagnetic layers of said two or more antiferromagnetically coupled ferromagnetic layers a non-magnetic space layer is sandwiched.

3. The MRAM unit according to claim 1, wherein each of said plurality of memory cells further comprises a free magnetic layer and a cap layer.

4. The MRAM unit according to claim 1, further comprising a plurality of heat elements, each of said plurality of heat elements being thermally coupled, respectively, to each of said plurality of memory cells.

5. The MRAM unit according to claim 4, wherein each of said plurality of heat elements is adapted to heat said respective one of said plurality of memory cells

to a value approaching or exceeding the critical temperature of said SAFP recording layer.

6. The MRAM unit according to claim 4, wherein each of said plurality of heat elements is a non-linear element.

7. The MRAM unit according to claim 6, wherein said non-linear element is one of the group comprising: a Zener diode and a field-effect transistor.

8. The MRAM unit according to claim 1, wherein each of said plurality of memory cells is a current-in-plane memory cell.

9. The MRAM unit according to claim 8, wherein said current-in-plane (CIP) memory cells are CIP spin-valve memory cells.

10. The MRAM unit according to claim 1, wherein each of said plurality of memory cells is a current-perpendicular-to-plane (CPP) memory cell.

11. The MRAM unit according to claim 10, wherein said CPP memory cells are magnetic tunnel junction memory cells.

12. The MRAM unit according to claim 10, wherein said CPP memory cells are CPP spin-valve memory cells.

13. The MRAM unit according to claim 1, wherein said free magnetic layer comprises magnetic material with higher critical temperature than that of said SAFP recording layer.

14. A method of writing data in a MRAM unit which comprises a plurality of memory cells, a bit line and a word line both in electrical contact with said plurality of memory cells, each of said plurality of memory cells comprising a synthetic antiferromagnetic pinned (SAFP) recording layer, said SAFP recording layer

comprising two or more antiferromagnetically coupled ferromagnetic layers pinned by at least one antiferromagnetic layer, said method comprising:

raising the temperature of said SAFP recording layer in an individual memory cell to a value approaching or exceeding its critical temperature independently of other memory cells, thereby reducing the coercitivity of said SAFP recording layer; and

writing a magnetization state in said SAFP recording layer of said individual memory cell by passing a first current completely through said bit line and by passing a second current completely through said word line.

15. The method according to claim 14, further comprising cooling down said SAFP recording layer in said individual memory cell to nearly ambient temperature after writing said magnetization state in said SAFP recording layer of said individual memory cell.

16. The method according to claim 14, wherein raising the temperature of said SAFP recording layer in said individual memory cell to a value approaching or exceeding its critical temperature independently of other memory cells further comprises passing a heating current partly through said bit line, completely through said individual memory cell and partly through said word line.

17. The method according to claim 16, said method further comprising providing a heating element adjacent said individual memory cell before said step of raising the temperature of said SAFP recording layer in said individual memory cell to a value approaching or exceeding its critical temperature independently of other memory cells.

18. The method according to claim 17, wherein passing a heating current partly through said bit line, completely through said individual memory cell and partly through said word line further comprises also passing said heating current completely through said heating element.

19. The method according to claim 17, said method further comprising providing a non-linear element as heating element.

20. The method according to claim 19, said method further comprising providing a Zener diode or a field-effect transistor as non-linear element.

21. A method of performing a read operation in a MRAM unit which comprises a plurality of memory cells, a bit line and a word line both in electrical contact with the plurality of memory cells, each of said plurality of memory cells comprising a synthetic antiferromagnetic pinned (SAFP) recording layer and a free magnetic layer, said SAFP recording layer comprising two or more antiferromagnetically coupled ferromagnetic layers pinned by at least one antiferromagnetic layer, the method comprising:

applying currents through said bit line and said word line; and

determining the magnetization state of said SAFP recording layer, wherein the resistance states of said SAFP recording layer are dependent on the relative angles between the magnetization vectors of said SAFP recording layer and said free magnetic layer.